



MARKSCHEME

November 2008

BIOLOGY

Higher Level

Paper 2

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General Marking Instructions

Subject Details: **Biology HL Paper 2 Markscheme**

Mark Allocation

Candidates are required to answer **ALL** questions in Section A [**32 marks**] and **TWO** questions in Section B [**2 × 20 marks**]. Maximum total = [**72 marks**]

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.
2. Each marking point has a separate line and the end is signified by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).
8. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded.
9. Only consider units at the end of a calculation. Unless directed otherwise in the markscheme, unit errors should only be penalized once in the paper.

Section B

Extended response questions - quality of construction

- ♦ Extended response questions for HL P2 carry a mark total of **[20]**. Of these marks, **[18]** are awarded for content and **[2]** for the quality of construction of the answer.
- ♦ Two aspects are considered:
 - expression of relevant ideas with clarity
 - structure of the answers.
- ♦ **[1]** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **[2]** quality marks are awarded when a candidate satisfies **BOTH** criteria.

Clarity of expression:

The candidate has made a serious and full attempt to answer all parts of the question and the answers are expressed clearly enough to be understood with little or no re-reading.

Structure of answer:

*The candidate has linked relevant ideas to form a logical sequence **within** at least two parts of the **same question** (e.g. within part a and within part b, or within part a and within part c etc. but **not between** part a and part b or between part a and part c etc.).*

SECTION A

1. (a) (i) *either: calculated from the leading half of disc halves.*
experiment 1: 47%; (allow 46.7%)
experiment 2: 80%; *[1 max]*
To award the mark both experiments must be calculated.

or: calculated from leading quarter of disc quarters.
experiment 1: 20%;
experiment 2: 50%; *[1 max]*
To award the mark both experiments must be calculated.
- (ii) growth towards target occurs in both experiments;
 more growth toward target in experiment 2;
 experiment 1 shows more even/random distribution of growth while
 experiment 2 shows (very) uneven distribution of growth; *[2 max]*
- (b) control / use as reference for comparison / ensure that no other factor (other than the tomato) is responsible for the effect *[1]*
- (c) chemical extracts/volatiles from tomato plants appear to be reason for growth;
 age of tomato plants does not seem to affect seedling growth (since both 10-day-old and 20-day-old tomato plants attract seedlings);
 seedling growth not attracted to (shape of/material of) artificial plant;
 seedling growth not attracted to colour/by wavelength;
 moisture/control has no effect;
 results from experiments 5, 6, and 7 were similar to control; *[3 max]*
- (d) (i) 15 in each half / 50 : 50 / even distribution *[1]*
 (ii) test validity/probability/significance of results *[1]*
- (e) provides more detail/evidence (to confirm hypothesis);
 allows improved statistical analysis/more accurate data;
 shows whether more seedlings are growing towards target/away from target than expected by chance;
 more chances for chi-square analysis;
 if volatile is an attractant then expect more growth in bottom quarter; *[2 max]*

- (f) (i) results suggest that dodder seedlings are more strongly attracted to tomato plants / *vice versa*;
tomato plants have two volatile compounds/pinene and phellandrene that attract dodder, wheat plant has one/decanal;
tomato plants have no repelling volatile compounds, wheat plant has one/hexenyl acetate;
both plants have volatile compounds/limonene and nonanal which have a neutral effect/no effect; [3 max]
- (ii) could become a repellent (in spray to protect plants from dodder);
plants could be genetically engineered to produce their own hexenyl acetate for self-protection; [1 max]
- (iii) help plants locate other plants;
help plants to be selective about other plants / grow towards/away from other plants / avoid competition / gain resources from other plants;
attract/repel insects/pests; [2 max]
- (g) how do plants detect the volatile signal?;
how do plants respond to the signal, once detected?;
what other plants show the effect?;
does quantity make a difference (or is it all or none)?; [1 max]
Award any other reasonable suggestions (but please justify on the script).

2. (a) more than one codon specifies/codes for a particular amino acid [1]

- (b) Award [1] for every pair of ideas only if given difference is on same theme such as shape, binding etc.

<i>competitive inhibition</i>	<i>non-competitive inhibition</i>
inhibitor shape similar to substrate	inhibitor shape different from substrate;
inhibitor binds to active site	inhibitor binds to remote site (away from active site);
substrate binding to active site blocked	changes shape of active site;
enzyme activity is reduced	enzyme activity is reduced;
an increase in substrate concentration will increase the rate	an increase in substrate concentration will have no effect on the rate;

[2 max]

- (c) prophase I [1]

- (d) $\frac{Tb}{tb}$;
 $\frac{tB}{tb}$; [2]

Award [1 max] if linkage notation is not used.

3. (a) (when gates open) Na^+ moves in;
 (when gates open) K^+ diffuses out;
 sodium potassium pump establishes resting potential;
 by moving sodium out and potassium in; [2 max]

- (b) $NaCl/Na^+$ ions diffuse out of lower region of ascending limb;
 $NaCl/Na^+$ ions actively transported out of upper region of ascending limb;
 creates salt concentration gradient in medulla;
 counter-current multiplier/exchange mechanism;
 enables (possible) reabsorption of water from collecting duct; [3 max]

- (c) oxygen is the final acceptor of electrons/protons/ H^+ ;
 water is formed / oxygen is reduced;
 in the (mitochondrial) electron transport chain;
 (aerobic respiration) increases yield of ATP; [2 max]

- (d) protects against entry of pathogens into body [1]

SECTION B

Remember, up to TWO “quality of construction” marks per essay.

4. (a) Award **[1]** for each of the following clearly drawn and correctly labelled.
- tissue (ligament) – leading away from ovary / blood vessels in and out;
 - primary follicles – shown small in volume;
 - primary oocyte – shown surrounded by follicle;
 - zona pellucida – shown surrounding secondary oocyte;
 - developing follicles – shown getting bigger;
 - mature (Graafian) follicle;
 - secondary oocyte – { either labelled inside Graafian follicle or shown being released.
If released it must be smaller than follicle;
 - first polar body – shown very small;
 - ruptured follicle;
 - corpus luteum – { either degenerating or newly formed, shown larger than developing follicle; **[4 max]**
- Arrows or labels must point to correct feature, e.g. labels for “oocytes” must point to the oocyte inside the follicle, not just to the follicle.*
- (b) sperm cell nears egg (in oviduct);
- head (acrosome) of sperm cell releases (hydrolytic) enzymes;
 - enzymes digest (jelly layer/glycoprotein of) zona pellucida;
 - sperm cell head (acrosomal process) extends through jelly to vitelline membrane / egg plasma membrane;
 - binding proteins (on surface of acrosome) attach to receptors on vitelline membrane;
 - sperm plasma membrane fuses with egg plasma membrane;
 - fusion of plasma membranes causes depolarization of egg plasma membrane/
 - release of contents of cortical granules / cortical reaction;
 - bars other sperm cells from fusing with membrane;
 - sperm nucleus enters egg;
 - secondary oocyte / female cell completes meiosis II;
 - fusion of nuclei / dissolution of nuclear membranes / combination of genetic material; **[6 max]**
- (c) DNA (sequence) is copied to (m)RNA;
- DNA separated;
 - RNA polymerases separate the strands;
 - only one strand is copied/transcribed / antisense strand is transcribed;
 - RNA polymerase binds to promoter/initiation region (of template strand);
 - ATP provides energy for attachment;
 - nucleotides exist as nucleotide triphosphates;
 - removal of phosphates (2) from nucleotide triphosphates provides energy for linkage;
 - RNA polymerase catalyses the formation of the polymer / helps the nucleotides join;
 - (m)RNA lengthens in 5' to 3' direction;
 - RNA polymerase reaches terminator on DNA to stop transcription process;
 - mRNA is separated from DNA; **[8 max]**

(Plus up to [2] for quality)

5. (a) *fungi: [1 max]*
Athletes' foot (Tinea pedis);
ringworm;
histoplasmosis;
keratitis;
oculomycosis;
- protozoa: [1 max]*
malaria;
leishmaniasis;
giardiasis;
amoebic dysentery;
- flatworm: [1 max]*
schistosomiasis (bilharzias);
- roundworm: [1 max]*
ancylostomiasis (hookworm disease);
trichinosis; [4 max]
Allow other correct examples.
- (b) macrophages engulf antigen/pathogen (by phagocytosis);
display antigen on membrane;
on MHC protein;
activate helper T-cells;
which activate B-cells;
to divide and clone;
to produce plasma cells;
which produce antibodies;
which inactivate/bind to the antigens;
memory cells remain for long-term protection;
have antibodies on surface; [8 max]
- (c) *benefits: [3 max]*
possible eradication of disease;
reduced suffering/cost of treatment;
prevention of death / immunity from the disease;
long-term disabilities reduced;
e.g. sterility from mumps / congenital defects from rubella;
prevent epidemics;
- dangers: [3 max]*
immune system compromised to fight new diseases;
immunity may not be life-long;
may contract disease from vaccine;
vaccination may cause side effects / named side effect *e.g.* allergic reaction; [6 max]

(Plus up to [2] for quality)

6. (a) Award [1] for each correct row.

<i>function</i>	<i>example</i>
bind/transport oxygen	myoglobin/hemoglobin;
bind bacteria/viruses/“foreign” molecules	antibodies/immunoglobulins;
contractile force for muscle contraction / regulate muscle contraction	actin (and myosin) / tropomyosin (and troponin);
speeding up metabolic reactions / enzymes / catalyst e.g. degradation of H_2O_2 within cell/e.g. digestion of protein	peptidase / catalase; } <i>must be a named enzyme and must correspond to the function on left</i>
structural support	collagen/keratin/fibrin;
storage	casein;
hormone/chemical messenger / e.g. regulate blood glucose	insulin;
zinc finger protein	transcriptional regulators;

[4 max]

Award any other suitable function with a named example. Examples can be general or specific.

- (b) consists of ribonucleic acid (RNA);
and protein (in each subunit);
two (irregularly shaped) subunits / one large subunit and one small subunit;
there are two sizes of ribosomes / prokaryotic and eukaryotic / 70S and 80S;
cleft/binding site (between subunits) for mRNA;
two/three binding sites for tRNA;
relative to other organelles, ribosomes are smaller;
ribosomes may be attached to endoplasmic reticulum/may be free in cytoplasm;
ribosomes may form polysomes;

[6 max]

- (c) membrane enclosed sacs found within plant and animal cell / can store materials;
e.g. enzymes (lysosomes and peroxisomes);
e.g. neurotransmitters;
vesicles isolate enzymes to protect rest of cell from reactions;
can transport materials within cell;
transport between rough ER and Golgi apparatus;
bud off rough ER carry proteins made by ribosomes (on rough ER);
fuse to (cis face of) Golgi apparatus can bud off (trans face of) Golgi apparatus;
as secretory vesicles;
travel from Golgi apparatus plasma membrane;
fuse with plasma membrane;
exocytosis;
release contents to outside (extra cellular fluid);
(vesicles formed at plasma membrane by) endocytosis;

[8 max]

(Plus up to [2] for quality)

7. (a) *Award [1] for each of the following clearly drawn and correctly labelled.*
 double outer membrane/envelope – shown as two concentric, continuous lines close together;
 granum/grana – shown as a stack of several disc shaped subunits;
 thylakoid membrane – shown connecting at least two grana;
 ribosomes / circular DNA / lipid globules / starch granules / stroma; **[4 max]**
- (b) CO_2 is fixed to form a carbohydrate;
 ATP and NADPH produced in light dependent reactions used in light independent reactions;
 glyceraldehydes / three-carbon sugar;
 occurs in stroma of chloroplast;
 ribulose biphosphate carboxylase (Rubisco) catalyzes attachment of CO_2 to (five-carbon sugar) ribulose biphosphate (RuBP);
 (unstable six-carbon intermediate) forms two molecules of glycerate-3-phosphate;
 each (of two) glycerate-3-phosphate then receives one phosphate from ATP;
 each (of two) phosphorylated glycerate-3-phosphate is reduced by $\text{NADPH}^+ + \text{H}^+$;
 result is (two molecules of) glyceraldehyde phosphate/triose phosphate (TP);
 for every six molecules of glyceraldehyde phosphate one goes to form glucose/
 glucose phosphate;
 remaining molecules reorganized to RuBP;
 reorganization requires ATP;
 RuBP allows cycle to start again; **[8 max]**
- (c) *xerophytes: [3 max]*
 live in dry environments;
 have small/thick leaves/spines/rolled leaves/needles;
 reduced surface area to volume ratio;
 thick cuticle;
 fewer stomata / located in depressions / surrounded by hairs;
 some shed leaves during driest months;
 widespread shallow network of roots / deep tap roots / water storage areas;
- hydrophytes: [3 max]*
 live in/on water;
 buoyant leaves (with air spaces);
 stomata on upper surface of leaves;
 waxy cuticle on upper surface of leaves;
 minimal amounts of xylem (in stems and leaves);
 reduced roots; **[6 max]**

(Plus up to [2] for quality)